UART唤醒并且频率补偿

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

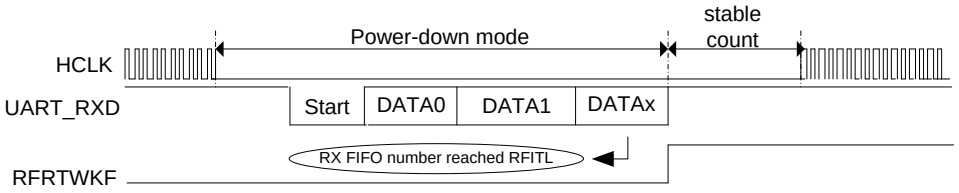
代码简述	本范例代码使用UART把M480从低功耗模式唤醒并进行频率补偿
BSP 版本	M480 Series BSP CMSIS V3.04.000
开发平台	NuMaker-PFM-M487 Ver 3.0

1 功能介绍

1.1 简介

此范例程序中，M480会进入power down模式，当所收到UART的数据达到门坎值，即会唤醒M480。由于power down模式下 UART 时钟源需要设为 LXT，因此使用UART鲍率补偿以达到更准确的频率。使能缓存器WKRFRTEN(UART_WKCTL[2])可开启UART唤醒功能。

进入power down模式后，当RX FIFO里接收到的数据达到了门坎值设定 RFITL (UART_FIFO[7:4])，会触发接收数据标志 RFRTWKF(UART_WKSTS[2])。下图是UART接收数据达到门坎值唤醒示意图：



1.2 原理

使用者可以在BRCOMP(UART_BRCOMP[8:0])设定需要补偿的位，并且在BRCOMPDEC(UART_BRCOMP[31])设定正补偿或是负补偿，使所设定的位数据时间增加或减少1个UART的频率。以下为缓存器说明：

Bits	Description	
[31]	**BRCOMPDEC**	**Baud Rate Compensation Decrease** 0 = Positive (increase one module clock) compensation for each compensated bit. 1 = Negative (decrease one module clock) compensation for each compensated bit.
[30:9]	**Reserved**	Reserved.
[8:0]	**BRCOMP**	**Baud Rate Compensation Patten** These 9-bits are used to define the relative bit is compensated or not. BRCOMP[7:0] is used to define the compensation of UART_DAT[7:0] and BRCOM[8] is used to define the parity bit.

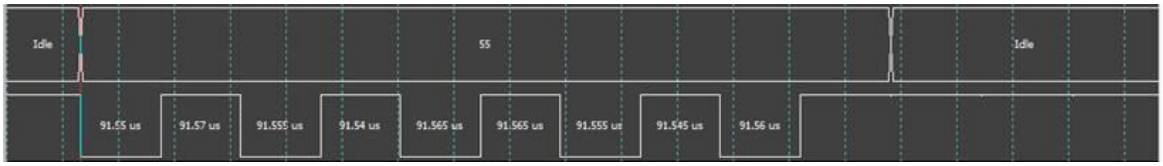
范例如下：

UART peripheral clock = 32.768K (LXT)

UART Baud rate = 9600, 1bit = 104.167us

原波形会产生3个UART频率的时间来表示1个位的UART数据 ((1 / 32.768K) * 3 = 91.55us)，

波形如下：



设定补偿缓存器如下：

BRCOMP[8:0] = 0x0010100101

BRCOMPDEC[31] = 0

因此在bit0, bit2, bit5, bit7会补偿1个UART频率的时间 = ((1 / 32.768K) * (3+1) = 122.07us)

波形如下：

开启补偿功能可以控制UART鲍率的误差在± 0.5个UART频率的时间以内。

2 代码介绍

首先设定UART1的传输速率为9600，并且对bit0, bit2, bit5, bit7做频率补偿。接着开启UART唤醒功能，再来设定UART接收数据的门阀值。其程序代码如下：

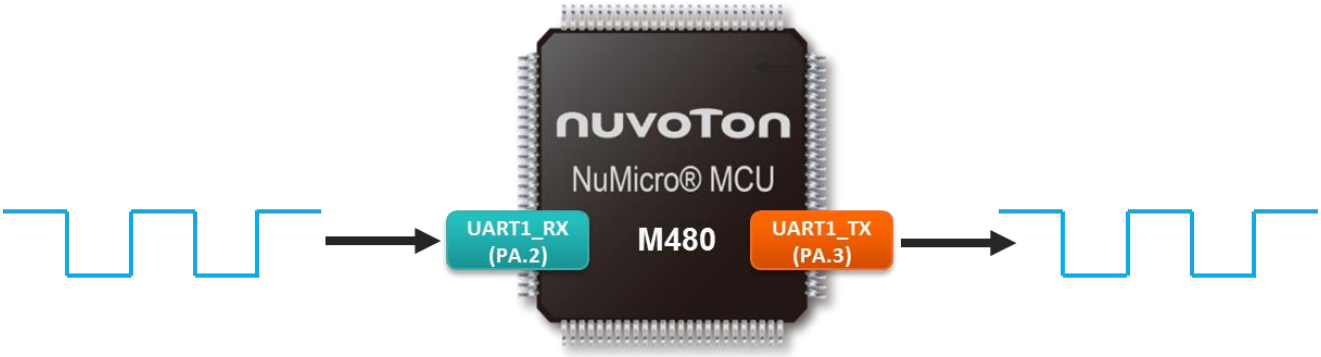
```
void UART_FunctionTest()
{
    SYS_UnlockReg();

    /* Configure UART1 and set UART1 baud rate */
    UART_Open(UART1, 9600);

    /* Set Compensation in bit0, bit2, bit5, bit7 */
    UART1->BRCOMP = 0xA5;

    g_bWait = 0;

    UART1->WKCTL = UART_WKCTL_WKRFRTEN_Msk;

    /* Enable UART RDA/THRE/Time-out interrupt */
    NVIC_EnableIRQ(UART1_IRQn);
    UART_EnableInt(UART1, (UART_INTEN_WKIEN_Msk));

    CLK->PWRCTL |= CLK_PWRCTL_PDWKIEN_Msk;
    NVIC_EnableIRQ(PWRWU_IRQn);

    /* clear status */
    UART1->WKSTS = UART1->WKSTS;

    /* Wait debug message finish */
    while((UART0->FIFOSTS & UART_FIFOSTS_TXEMPTYF_Msk) == 0);

    UART1->FIFO &=~ UART_FIFO_RFITL_Msk;
    UART1->FIFO |= UART_FIFO_RFITL_4BYTES;

    /* Enter to Power-down mode */
    CLK_PowerDown();

    while(!g_bWait);
    CLK_SysTickLongDelay(1000000);
```

```
    /* Disable UART RDA/THRE/Time-out interrupt */
    UART_DisableInt(UART1, UART_INTEN_WKIEN_Msk);
    g_bWait = TRUE;

    printf("\n\n%x\n",UART_READ(UART1));
    printf("\n\n%x\n",UART_READ(UART1));
    printf("\n\n%x\n",UART_READ(UART1));
    printf("\n\n%x\n",UART_READ(UART1));

    printf("\n\nUART Wakeup Compensation Sample Demo End.\n");
}
```

3 软件与硬件环境

- 软件环境
  - BSP 版本
    - M480 Series BSP CMSIS V3.04.000
  - IDE 版本
    - Keil uVersion 5.26
- 硬件环境
  - 电路组件
    - NuMaker-PFM-M487 or other M480 Development Board
  - 示意图

从 UART1_RX(PA.2)输入讯号，当数据达到门坎值时会唤醒 M480。



4 目录信息

- EC_M480_UART_Wakeup_Compensation_V1.00
  - Library — Sample code header and source files
    - CMSIS — Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
    - Device — CMSIS compliant device header file
    - StdDriver — All peripheral driver header and source files
  - SampleCode
    - ExampleCode — Source file of example code

5 如何执行范例程序

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 UART_Wakeup_Compensation.uvproj
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开除错模式
3. 进入除错模式接口
   a. 执行代码

6 修订纪录

Date	Revision	Description
Oct. 1, 2019	1.00	1. 初始发布.

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